

# Deep Learning

## homework

**Course name : Deep Learning**

**Course id : 14448\_001**

**Student ID : 201734215**

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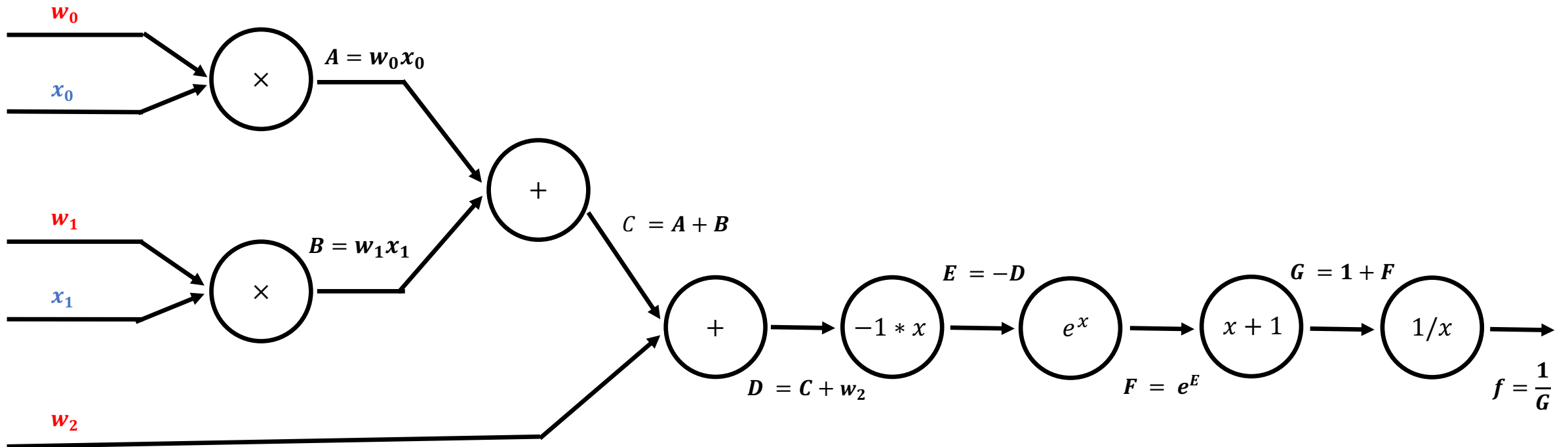
**Major : Electircal Engineering**

**Submission date : 2022/03/29**

# Step1. Computational Graph

$$C = f^2, \quad f = \frac{1}{1 + e^{-(w_0x_0 + w_1x_1 + w_2)}}$$

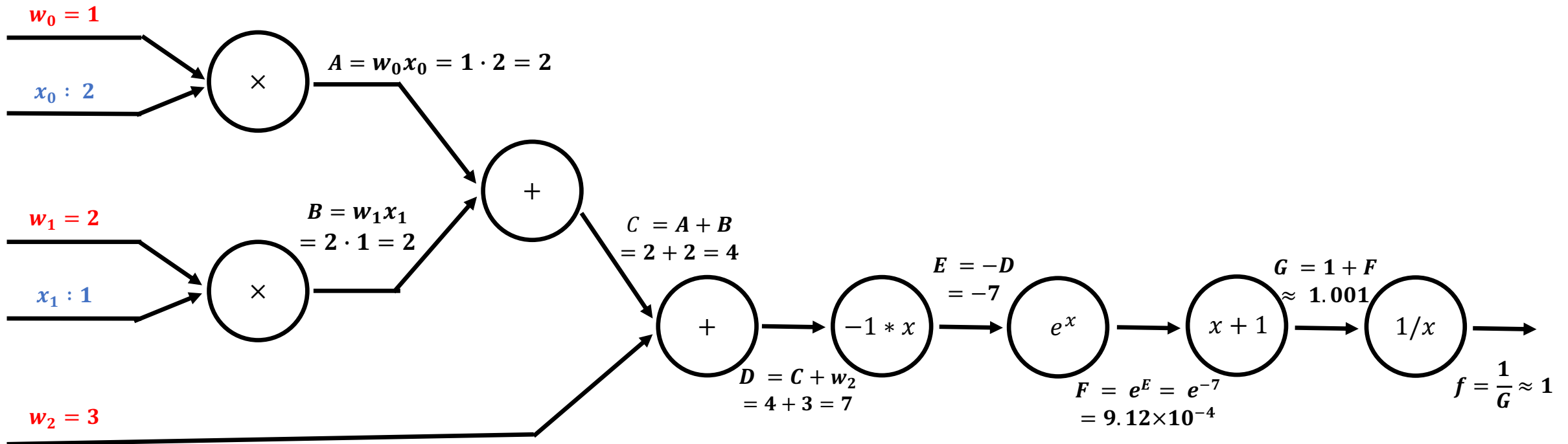
$$f = \frac{1}{1 + e^{-(A + B + w_2)}} = \frac{1}{1 + e^{-(C + w_2)}} = \frac{1}{1 + e^{-D}} = \frac{1}{1 + e^E} = \frac{1}{1 + F} = \frac{1}{G}$$



## Step2. Feed Forward

$$C = f^2, \quad f = \frac{1}{1 + e^{-(w_0x_0 + w_1x_1 + w_2)}}$$

$$f = \frac{1}{1 + e^{-(A+B+w_2)}} = \frac{1}{1 + e^{-(C+w_2)}} = \frac{1}{1 + e^{-D}} = \frac{1}{1 + e^E} = \frac{1}{1 + F} = \frac{1}{G}$$



## Step3. Obtain Derivatives

$$C = f^2, \quad f = \frac{1}{1 + e^{-(w_0 x_0 + w_1 x_1 + w_2)}}$$

$$f = \frac{1}{1 + e^{-(A+B+w_2)}} = \frac{1}{1 + e^{-(C+w_2)}} = \frac{1}{1 + e^{-D}} = \frac{1}{1 + e^E} = \frac{1}{1 + F} = \frac{1}{G}$$

$$\begin{aligned} \frac{\partial C}{\partial w_0} &= \frac{\partial C}{\partial A} \frac{\partial A}{\partial w_0} \\ &= 1.82 \times 10^{-3} \cdot 2 \\ &= 3.64 \times 10^{-3} \end{aligned}$$

$$w_0 = 1$$

$$x_0 : 2$$

$$\begin{aligned} \frac{\partial C}{\partial w_1} &= \frac{\partial C}{\partial B} \frac{\partial B}{\partial w_1} \\ &= 1.82 \times 10^{-3} \cdot 1 \end{aligned}$$

$$w_1 = 2$$

$$x_1 : 1$$

$$w_2 = 3$$

$$\begin{aligned} \frac{\partial C}{\partial A} &= \frac{\partial C}{\partial C} \frac{\partial C}{\partial A} \\ &= 1.82 \times 10^{-3} \cdot 1 \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial B} &= \frac{\partial C}{\partial C} \frac{\partial C}{\partial B} \\ &= 1.82 \times 10^{-3} \cdot 1 \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial C} &= \frac{\partial C}{\partial D} \frac{\partial D}{\partial C} \\ &= 1.82 \times 10^{-3} \cdot 1 \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial w_2} &= \frac{\partial C}{\partial D} \frac{\partial D}{\partial w_2} \\ &= 1.82 \times 10^{-3} \cdot 1 \end{aligned}$$

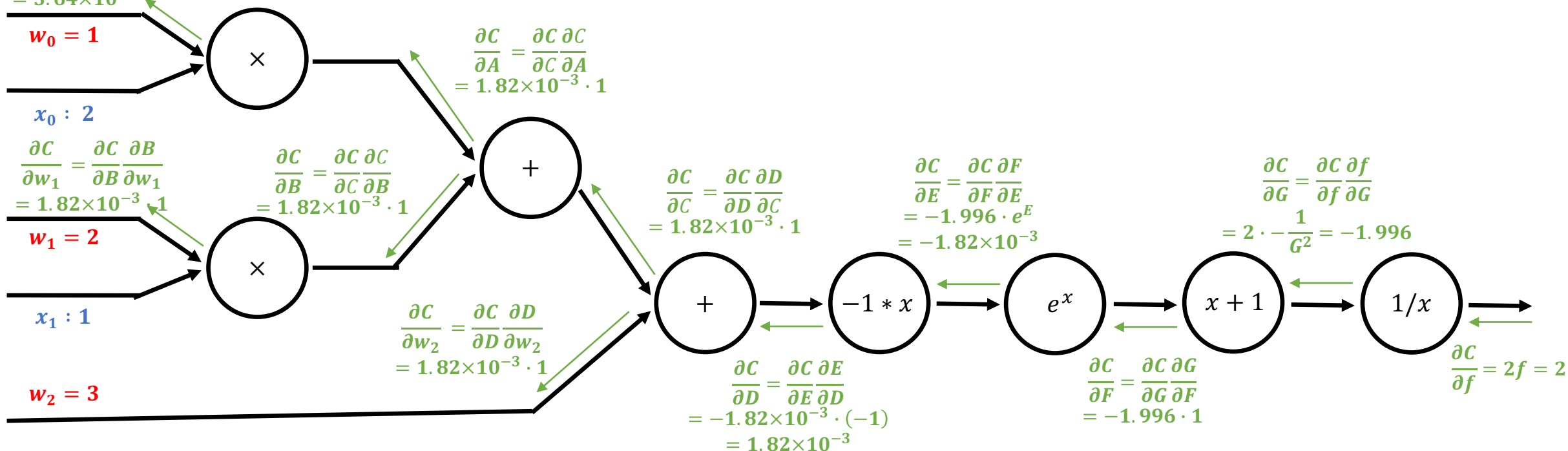
$$\begin{aligned} \frac{\partial C}{\partial E} &= \frac{\partial C}{\partial F} \frac{\partial F}{\partial E} \\ &= -1.996 \cdot e^E \\ &= -1.82 \times 10^{-3} \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial G} &= \frac{\partial C}{\partial f} \frac{\partial f}{\partial G} \\ &= 2 \cdot -\frac{1}{G^2} = -1.996 \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial D} &= \frac{\partial C}{\partial E} \frac{\partial E}{\partial D} \\ &= -1.82 \times 10^{-3} \cdot (-1) \\ &= 1.82 \times 10^{-3} \end{aligned}$$

$$\begin{aligned} \frac{\partial C}{\partial F} &= \frac{\partial C}{\partial G} \frac{\partial G}{\partial F} \\ &= -1.996 \cdot 1 \end{aligned}$$

$$\frac{\partial C}{\partial f} = 2f = 2$$



## Step4. Update Parameters

$$w_i := w_i - \alpha \frac{\partial f}{\partial w_i}, \quad \alpha = 0.1$$

$$w_0 = 1 - 0.1 \times 3.64 \times 10^{-3} \\ = 0.9996$$

$$\frac{\partial C}{\partial w_0} = 3.64 \times 10^{-3}$$

$x_0 : 2$

$$w_1 = 2 - 0.1 \times 1.82 \times 10^{-3} \\ = 1.9998$$

$$\frac{\partial C}{\partial w_1} = 1.82 \times 10^{-3}$$

$x_1 : 1$

$$w_2 = 3 - 0.1 \times 1.82 \times 10^{-3} \\ = 2.9998$$

$$\frac{\partial C}{\partial w_2} = 1.82 \times 10^{-3}$$

*The values of  $w_0, w_1, w_2$  after back – propagation once*

$$w_0 = 0.9996$$

$$w_1 = 1.9998$$

$$w_2 = 2.9998$$

